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VARIATION AMONG NON-LOBED SASSAFRAS LEAVES*

By Edwin W. Humphreys

Sassafras is for various reasons one of the most interesting of our native trees. One of the interesting features, and the one that has probably attracted the most attention to the tree, is its variously shaped leaves. That each of these leaf forms in turn shows considerable variation in its characters is apparently not so definitely known, and the limits of such variation are still less known. Yet a study of these differences is of much interest, particularly from the viewpoint of paleobotany; for most of the identifications of fossil plants are based on leaves only and naturally the limits of leaf variation are of more importance to the paleobotanist than they are to the botanist who has, in addition to the leaves, other characters on which to base his identifications. It was for the purpose of determining, in a measure, how greatly the non-lobed sassafras leaves varied among themselves that the present study, based on leaves collected at random in Bronx and Pelham Bay Parks, New York, and on the Palisades of New Jersey, was made.

The most obvious variation is in the proportion of length to breadth. At one extreme is a leaf in which the length is only one and two fifths times the breadth, making an almost circular leaf; while at the other is a leaf whose length is three and one half times the breadth, producing a very long narrow leaf. By dividing the leaves into groups based on the relation between breadth and length, the following curve was prepared (Fig. 1). It should be stated that all the curves given here are based on the same five hundred leaves. The figures along the base line

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indicate the ratio between breadth and length adopted for each group, while the height of the curve is determined by the number of individual leaves in that group. It appears, from the curve, that the normal or common type of leaf is that which is about twice as long as it is broad. The progression from very

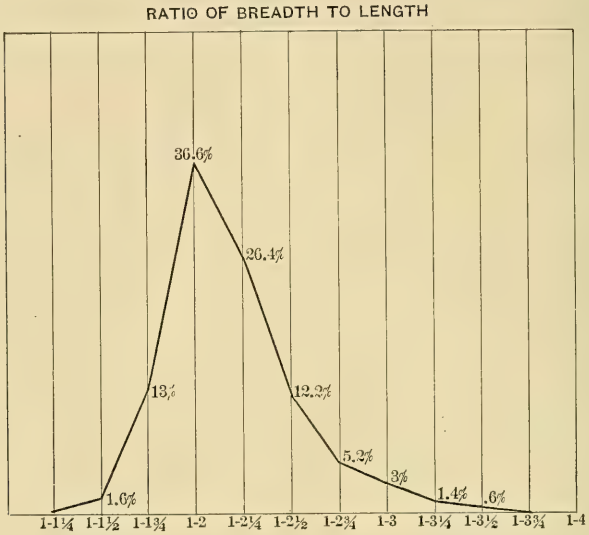

FIGURE 1.

broad leaves to the common form is very abrupt, while that toward the long narrow forms, though still abrupt, is somewhat gentler, tending to show that variants toward the long narrow types are more common, at least among the leaves measured, than are those toward the broader forms.

The shape of a leaf depends chiefly upon the relationship existing between its length and breadth, and upon the position of the broadest part of the blade. Therefore the curve expressing this relationship is to a certain extent prophetic as to what the predominant shape will be. It indicates that the ovate, obovate, oval, and elliptical leaves are likely to be in the majority. Which of these four forms will, however, predominate depends upon the position of the widest part of the leaf. The accuracy of this forecast is shown by the curve (FIG. 2). It

shows that the greater number of leaves are of the shapes mentioned. And, since the widest part is for the most part near the middle, the dominant shape is oval.

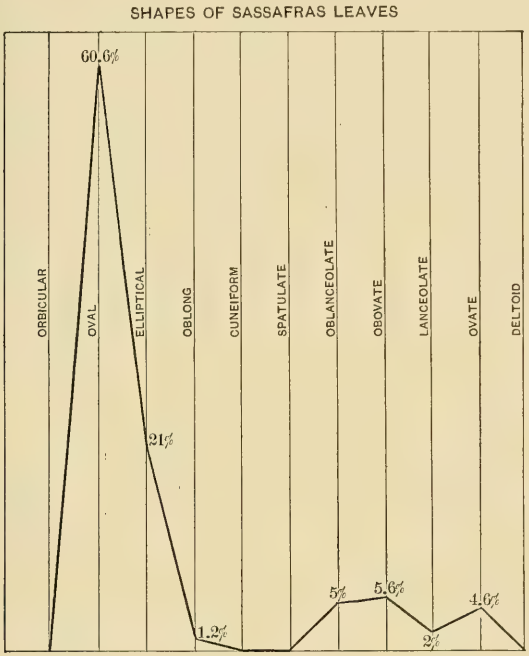

FIGURE 2.

In regard to the form of the tip there is also much variation. As most of the leaves are oval, obtuse tips might be expected to prevail. Though the curve (FIG. 3) shows that this is true, yet a surprisingly large number of other forms are shown. Some of these, for instance the emarginate, may possibly be due to wounding, but that cause can hardly be advanced for all of the variants.

On the condition of the base, sassafras leaves may be divided into two large classes. The first of these includes those leaves in which the blade begins at opposite points on the petiole ; the second those in which the blade starts at points that are not opposite, one side beginning at a point either higher or lower than

the other. Of the leaves here studied two hundred and seventy-six, or 55.2 per cent. were of class one, while two hundred and twenty-four, or 44.8 per cent. belonged to class two. Thus the opposite type is apparently the more common.

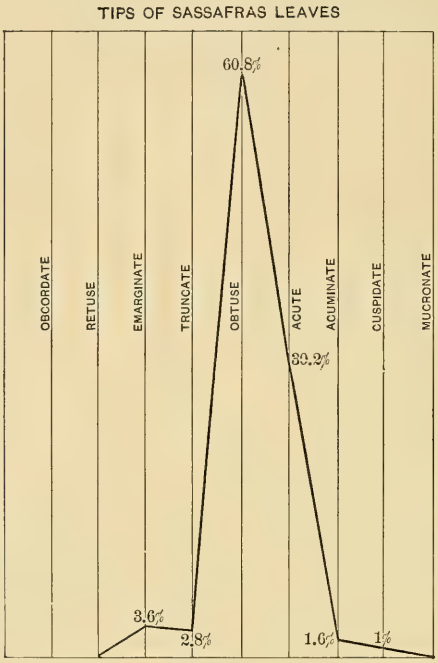

FIGURE 3.

According to the outline of the base, the leaves were divided into four classes. The first of these (FIG. 4) may be called the acute type. The second (FIG. 5) is wedge-shaped, while the third (FIG. 6) is the rounded type. The fourth class consists of mixed types. For example one side of the base of the blade may be wedge-shaped and the other may be rounded, and so on through the various possible combinations. A curve (FIG. 7) based upon these four classes shows at a glance that the acute type (FIG. 4) leads all the others.

An attempt may now be made to formulate what may be regarded as the chief characters of the most common sassafras leaves. The study just completed shows that such a leaf is

about twice as long as broad, oval in outline, with an obtuse tip, the base of the blade acute and commencing at opposite points on the petiole.

There remains now to be considered the characters of the venation. In all sassafras leaves, the midvein extends from the base as a petiole. In some bud leaves the parenchyma of the blade continues as a wing-like appendage along each side of the midvein to the point of attachment. As the leaves become older this appendage is not found, and the petiole is channeled.

Upward the midvein passes to the tip of the leaf, sometimes forming a short, sharp projection, sometimes a cusp. At times, the parenchyma extends beyond the end of the midvein, forming

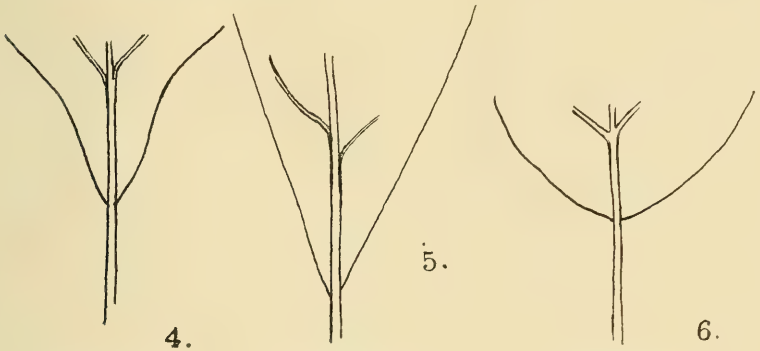

FIGURE 4. Acute type of base.

FIGURE 5. Wedge type of base.

FIGURE 6. Rounded type of base.

an emarginate tip. This is probably due to an arrestation of the growth of the midvein, while the parenchyma on either side continues to grow.

From the midvein a number of secondaries are given off. As these soon curve upward and loop into the next succeeding vein, the nervation may be described as pinnate-camptodrome. Two large secondaries always branch off from the midvein near its base. The disposition of these is not the same in all leaves. Sometimes they are opposite, while at other times they are not. Of the five hundred leaves examined 18.8 per cent. were opposite and the remaining 81.2 per cent. were not. It may be remembered in this connection that the majority of the bases of the leaf

margin were opposite. From the above it may be inferred that if the position of these first, and by far the largest secondaries, affected the condition of the base, as to its being opposite or not, the greater number of leaves would not have had opposite bases, but this in the leaves examined is not so. Hence it would appear that the position of the first secondaries does not affect the base.

The secondaries arise at different angles in different leaves. The largest angle found for the lowest secondaries was 74

FIGURE 7.

degrees, the smallest 27 degrees. The usual angle is apparently somewhere between 40 and 50 degrees. The other and smaller secondaries likewise leave the midvein at various angles. These are, however, as a rule much larger than the angles at which the first two secondaries depart from the midvein. Sometimes the angles of departure of the smaller secondaries are as large as 90 degrees. The largest angle measured was 93 degrees. Another point in regard to the secondaries is that they are con-

fluent with the midvein before branching off. After leaving it they branch upward in the manner described, though they sometimes fork (Fig. 8).

Besides the larger secondaries described above, there also extend from the midrib a number of smaller ones that may be classed with the tertiaries, as they usually connect with them.

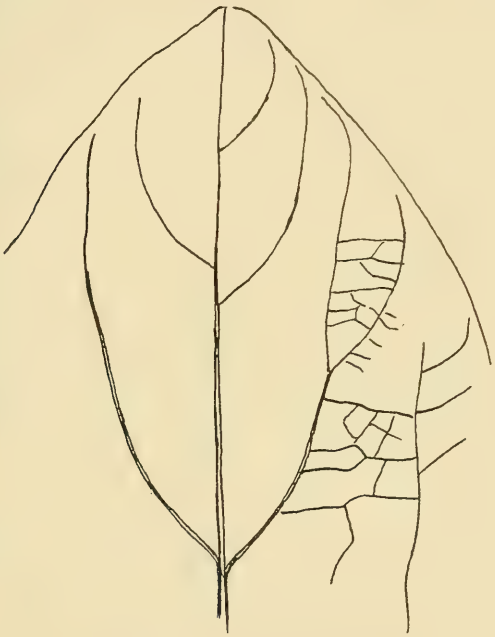

FIGURE 8. Leaf showing forked secondary.

It often happens, though, especially when there is a particularly large gap between any secondary and the one next succeeding it, that one of these smaller veins is so strongly developed that it takes the place of a larger one. They may, however, be easily distinguished from the others by the fact that they do not extend out far enough to form a part of the regular secondary system.

Connecting the secondaries with each other is a series of tertiaries which are much smaller than the veins just considered and which tend to form oblong or quadrangular areolae. Usually, they are rather uniform in size, but they often vary, particularly

those projecting from the outer and lower side of the first and largest pair of secondaries. When there is a narrow margin bordering these veins, the tertiaries proceeding from them are not very strongly developed; but when this margin is wide, they are very strong. Further, when one side is wider than the other the tertiaries of the wider margin are the more strongly developed.

Joining the tertiaries are the quaternaries which also exhibit a tendency to form quadrangular areolae. These, particularly when the tertiaries are strong, may be quite marked, but as a rule they are rather weak.

The nervation may now be briefly described as pinnate and camptodrome, with the two lowest secondaries very much larger than any of the others, while the tertiaries and quaternaries tend to form quadrangular areolae.

Finally, it may be noted that the facts here presented in regard to the form and venation of the leaves studied tend to show that the practice in vogue among paleobotanists of placing more emphasis upon the venation, for purposes of identification, than upon the form, is a sound one, based upon an appreciation of the more constant characteristics of the former.

THE VITALITY OF PINE SEED IN SEROTINOUS CONES

By J. C. Blumer

It has long been observed by naturalists that the cones of the group of pines known as jack pines, and some others, often carried closed cones upon their branches for many years. As has been observed for *Pinus attenuata* by John Muir and others, this serotinous character may be a potent factor in producing the aggressive restocking of forest land that has been burned over, characteristic of several such species, a fact of importance in forestry as well as ecology.

In the southwest, this group of pines is represented by *P. chihuahuana*, and it has the same habit of carrying aged cones. One instance is on record in which a cone belonged to a node